

ent jamais la région zénithale qu'ils n'atteignent même pas. Cette seule circonstance distingue profondément les cumulus des fracto-cumulus." Truly a profound distinction! We had supposed that in regard to clouds, as in some other matters, "one man's horizon is another man's zenith." Are cloud-classifiers really driven to such extremities? What would be thought of the botanist who appended to his description of the *Ulmaceæ* the statement that "the trees belonging to this family are objects seen upon the horizon," and then proceeded to meet the reasonable objection of the surprised reader by the remark that certainly the elm trees around his (the botanist's) residence, were all seen near the horizon? Yet this is how (p. 24) the author handles his descriptions of cumulus. (The fact of course is that the characteristic form of cumulus is not readily discernible when the cloud is near the zenith.) A somewhat similar remark, made by the author in explanation of the fact that a belt of cirrus, clearly visible towards opposite points of the horizon, is frequently invisible, or nearly so, overhead, is so strange that we must quote it. "Nous l'attribuons à l'extrême degré de froid que nous avons toujours observé dans la région zénithale, relativement aux autres azimuts. Sous cette basse température et cette extrême sécheresse, la vapeur d'eau se maintient à l'état élastique, et se précipite difficilement sous la forme de filaments extrêmement déliés. C'est pour cela que les cirrus sont plus rares, moins denses et passagers vers la région zénithale," (p. 69).

It is with reluctance that we notice statements of this kind in a work the general idea of which we admire, and in the aim of which we cordially sympathise.

W. CLEMENT LEY

THE PLANETS OF THE SEASON

MARS

IF the two great leaders of the planetary system have filled us with astonishment at their magnitude and velocity, and with perplexity in the contemplation of arrangements so incomprehensibly unlike our own, they have not exhausted all the resources of the season. There yet remains a much nearer and more intelligible neighbour, who possesses a peculiar interest for an opposite reason—his similarity to ourselves. This especial character of the ruddy planet has long been known to astronomers, and will naturally make him an object of careful study before we leave him too far behind; and though the opposition of this year does not diminish his distance so much as abot of 1877, yet his almost startling brilliancy has been lost though colpcove it among favourable ones; for English astronomers, at least, it is far more propitious than the last, from his greatly-increased elevation. Much had been expected at that last opposition from the broad expansion of his disk, but the indistinctness of detail was a general source of disappointment here, though the success of Schiaparelli at Milan and Green at Madeira showed that the fault lay chiefly—perhaps not exclusively—in the English sky. My own impression certainly then was that, besides the want of clear outline inseparable from so low an altitude, there was a deficiency in decidedness of form and strength of tone as compared with previous observations, the cause of which may have lain in the atmosphere of the planet, affected possibly by especial proximity to the sun in an orbit of considerable excentricity. At any rate, we may reasonably hope to find the present season more favourable for exploration than the last; for though at nearest approach we have only had 23" of disk instead of 29"·4 in 1877, success depends, with equal instrumental sharpness, much more upon altitude and steadiness of air than on increase of visible surface. Schiaparelli was enabled

to obtain his most valuable results after opposition, when the diameter had decreased to 20" or even 16", and he asserts that he was able to continue his researches with advantage even till it came down to less than 6".

We have alluded to the special interest of this planet arising from its supposed close correspondence with the earth, and it may not be out of place on this occasion if we bestow a little pains in examining the ground of that supposition. This we may conveniently do by imagining what would be the telescopic aspect of our own globe at a distance not equal to that of Mars, as we should then appear about twice as large, but such as to reduce our apparent diameter to equality with his in a favourable opposition.

There is every reason to believe that our surface would then appear mapped out by a distinct separation into oceans and continents, the fluid being darker than the solid masses, and preserving their bluish-green tinge but little affected by distance. Except in very shallow parts, their darkness would be uniform from the rapid absorption of incident light, and their contour would be sharply defined. The general hue of the land would be lighter; and at a distance where its variegated patches of colour would be separately undistinguishable, the result would be a grey resulting from the mixture of many tints, except where tracts such as the great deserts or prairies might subtend a sufficient angle to preserve their natural hue, or where extensive forests might rival seas in depth of tone. In many places, too, brilliant streaks and patches would show where mountain masses were capped with dense clouds, or surpassed the level of perpetual snow; but our largest rivers, except possibly at some great *embouchure*, would be totally imperceptible.

Such, in its general lineaments, would be the distant aspect of our globe, if the whole lay at once distinctly before the eye. But this would never be the case. The formation and transference of masses of vapour would produce incessant and most uncertain changes. In some regions and at certain times of year there would be unbroken clearness; in other tracts the outlines and colouring of land and sea would be indistinct, or concealed, at times for short, but occasionally for very lengthened, periods. And the interposition would doubtless be always of a white aspect, since such is the character of our clouds wherever they are illuminated by the sun. Towards our polar regions this whiteness would be permanent in the form of great spots, excentric as regards the axis of rotation, increasing through and after the winter, with a corresponding diminution after the summer solstice. There would always be, however, a large unmelted area, even at the warmest period, and its outlines would probably be on the itegale and extended from the presence of great features of fregns clouds. Now, if these would be the probable features of the earth, presented to us at a distance of seventy or eighty millions of miles, in what respects shall we be able to trace the resemblance on Mars? We are soon brought to the conclusion that, according to the general rule already referred to, there is more analogical than identical correspondence: the inclination of axis, the excentricity of orbit, the duration of day and night, the respective length of the seasons—from the relative similarity but not identity in these particulars, we are prepared to meet with the same kind of proportion throughout. As far as aspect goes, a solid and fluid condition may be thought to divide each superficies; but if so, the land there is in a much larger ratio to the water; and if the colour of our oceans is repeated on Mars, we have little to correspond with the orange-yellow tinge which, since it leaves unaffected the polar snows, cannot arise from atmospheric absorption. The so-called seas, too, though in some places apparently deep and dark, frequently shoal off and show subaqueous markings in a way that perhaps would be scarcely paralleled in our own.

In atmospheric conditions, indeed, we find great approach to identity; yet even here there are discrepancies; the polar snows of the earth would probably not be distinguishable from the upper surfaces of terrestrial clouds floating in any latitude, while on Mars such peculiar whiteness, though sometimes vividly brought out in certain localities, is by no means universally concurrent with the local indistinctness and confusion that so often puzzle the areographer. The action of solar heat on the polar deposits seems identical, and yet it may be a question whether our Arctic snows are marked out by as regular a contour as those of Mars, and still less would they show what has often been observed there—a strongly-marked border of darkness. And however striking and suggestive may be the fact that in either globe the thermal axis is not that of rotation, we have the discrepancy that on Mars the glaciation is reduced in a much greater ratio, so that the pole, according to Schiaparelli, was, in 1877, entirely free. This observer, who is fully impressed with the terrestrial theory, admits that the vertical sunlight, instead of producing clouds, as on the earth, appears to clear the sky of Mars, and thinks the atmospheric changes there of a more simple nature. That the southern hemisphere would be subject to greater extremes of temperature than the opposite, as shown by the variation in size of the white caps, might have been expected as a direct consequence of the elliptical form of its orbit greatly surpassing our own.

A passing reference will be sufficient to the brighter zone, which, according to some observers, distinguishes the edge of the disk, but which others, including myself, have never detected; or to the bluish or greenish patches sometimes noticed on the limb. Such appearances may be mere results of contrast; at any rate they may be left on one side as not directly affecting our present comparison. But there is one consideration which cannot be thus disposed of, and which, obvious as it is, seems to have been taken little into account—the very different amount of solar radiation on the two planets. The heat derived from the sun on Mars is only from $\frac{1}{3}$ to $\frac{1}{2}$ of that received by ourselves. And thus we seem reduced to the alternative of either abandoning to a considerable extent the supposed closeness of resemblance in material and constitution, or of maintaining it by the hypothesis of a supply of heat on Mars derived in some other way. No ice such as ours would be so reduced by the unaided action of that distant sun—no terrestrial continents could remain so long unclothed with snow. The dilemma is a curious one. It may not be incapable of explanation, but it certainly requires more special and careful consideration than it has yet received.

We have been looking at the subject much as though a supposed view of the earth at a suitable distance might be fairly paralleled with a corresponding representation of Mars as drawn by the best observers. But it must be added, with much regret, that such is not yet the case. As to certain main features of that planet, there is indeed a very satisfactory agreement; but with regard to others, and as to details in general, we feel, as a first impression, some extent of disappointment. It may be fairly admitted that the disk is after all not large, and its markings often feeble; and there is great diversity in instruments, and eyes, and hands, and aptitude for the work. Yet still an exhaustive survey, of which we cannot even indicate the materials in this place, but which we trust will be carried on, as it has been most ably commenced, by Dr. Terby of Louvain, would show much unexplained, and some things unsatisfactory. Mädler laid the foundation of definite areography; but his successors, while enlarging, have not always confirmed his results, and, to say nothing of others who have bestowed much pains upon the subject with more or less mutual agreement, our own keen-eyed and accomplished Dawes—at least as represented by Proctor—is found to differ

in some parts materially from Lockyer, Kaiser, and Secchi. At the last opposition in 1877, the subject was taken in hand with especial zeal and perseverance by Schiaparelli at Milan with an exquisitely sharp Merz object-glass of 7.15 inches aperture and 10 feet 8 inches focus, and by Green, who went out purposely to Madeira with a 13-inch mirror by With, the perfect polish and critical definition of which are sufficiently guaranteed by the maker's name. Each did his best; each was far in advance of the other observers of the season; and yet at first sight there is more apparent difference in their results than might have been expected. It is not surprising that in the case of minute details each should have caught something peculiarly his own; but there is a general want of resemblance not easily explained, till, on careful comparison, we find that much may be due to the different mode of viewing the same objects, to the different training of the observers, and to the different principles on which the delineation was undertaken. Green, an accomplished master of form and colour, has given a portraiture, the resemblance of which as a whole, commends itself to every eye familiar with the original. The Italian professor, on the other hand, inconvenienced by colour-blindness, but of microscopic vision, commenced by actual measurement of sixty-two fundamental points, and carrying on his work with most commendable pertinacity, has plotted a sharply-outlined chart, which, whatever may be its fidelity, no one would at first imagine to be intended as a representation of Mars. His style is as unpleasantly conventional as that of Green indicates the pencil of an artist; the one has produced a picture, the other a plan. The discordance arising from such opposite modes of treatment would naturally be less real than apparent; still, a good deal remains that it is not easy to harmonise. Let us hope that during the present favourable opportunity, much may be effected towards clearing up the obscurities that still rest upon the study of Mars. Every contribution may prove of use, provided it is the result of that conscientious spirit that will show only what it sees, and take care to show it well.

A suggestion may be permitted that observations in the twilight might obviate the unpleasant glare arising from the vivid light of the disk, or that a screen-glass might be advantageously employed for the same purpose at a later hour.

Meanwhile the nomenclature of the spots—a point of increasing importance for identification—is in a state of pitiable confusion. This ought to be remedied at once; and its revision could be more suitably intrusted to no one than to Dr. Terby, who so thoroughly knows its difficulties, and is so competent to decide upon some system that may be adopted with the general concurrence of observers.

With regard to the satellites, we have entered into so much detail about the primary, that little space remains for them. Yet we must express our hope that, once discovered, they may be more easily caught in our larger instruments, and that the magnificent reflector of Mr. Common may, as is very possible, increase their recognised number. Those already discovered are **certainly** among the most wonderful objects in the whole solar system. So disproportionally minute, according to our limited ideas of proportion; so speedy in their revolution that the innermost rises in the west and sets in the east, and compasses the whole heavens more than three times in a Martian day; so close that the same attendant ranges at less than 4,000 miles from the surface of his primary; so much of their time invisible in total eclipse; so powerless to influence any fluid mass beneath them; one might call them exceptions, while yet they are among the strongest illustrations of the great principle of identity of character combined with the extremest variety in detail, in the inscrutable work of the Creator.

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